STROBOSCOPIC DISPLAY DEVICE

Field of Invention

This invention relates to structural schemes and designs of programmed electronic-mechanical stroboscopic display devices intended to display apparent three-dimensional staying and moving, predominantly advertising, images as texts and/or pictures. Such devices can be used mainly at enterprises of mass service or exhibitions and fairs to attract clients and visitors by displaying illuminated advertising images externally and internally.

Prior Art

It is common knowledge that the stroboscopic effect is the basis of cinema and television (viz *McGraw-Hill Dictionary of Scientific and Technical Terms*, 2nd Ed., McGraw-Hill Book Company, New York, etc., 1978, p. 1553).

In cinema, this effect is realised by moving a cine film as a carrier of image information before a light source, which with a speed exceeding the human vision persistence time (≈ 0.1 s) sequentially displays separate film frames on a screen. In doing so, on the screen there can be seen staying and moving images. Like a film sequence, there are formed images in video sets and computer displays.

However, cine and video films prepared beforehand for advertising, e.g., at exhibitions and fairs, attract, as a rule, specialists only, since ordinary visitors became used to them long ago.

For advertising industrial equipment and materials, such means are quite satisfactory, but it is obviously unsatisfactory for attracting the public in mass to shops and catering establishments, and for advertising the goods of mass demand at exhibitions and fairs.

Also, advertising information can be relatively quickly adjusted only in computer displays using modern animation programs, while standard cines and videos are to monotonically be repeated during all the exposure time of promoted goods.

That is why the acknowledged experts in advertising K. BOVE and W. ARENS (viz *Contemporary Advertising*, 5th Ed., Richard D. Irwin, Inc., 1994) emphasise that the need for shared programs which can easily be readjusted to demonstrate frequently varying advertisements is pressing till now.

This need cannot be fully satisfied with either widely known programmed

matrix display devices of the type "travelling line" or multi-screen video advertising complexes. Commonly, as the basis of such a unit there serves a massive and cumbersome framework with hundreds (to thousands) light sources (LSs) mounted on its front in one line (or in more lines). These LSs are powered through a highly complicated controller such, for example, as known from US Patent 4,967,373. In particular, such a device is intended to control a multicoloured matrix display complex comprising —

a microprocessor;

address buffers and data buffers, each buffer associated with said microprocessor;

video memory planes, each video memory plane having an associated address buffer and an associated data buffer;

a graphic data control circuit to control each video memory plane;

a colour pallet circuit to monitor the display of the matrix display device, the circuit determining the actual colour image, arriving from each video memory plane, to be displayed;

said address and data buffers associated with said microprocessor and video memory planes to be commuted in accord with the microprocessor commands; and

a commutator associated with said graphic data control circuit to convert said image into electrical signals to control said projection complex.

Matrix display devices are known to be effective in delivering the news and advertising information for the public of a megalopolis. However, the like advertising for casual flows of people is of low effect, so the price of transmitted messages being too high to justify hopes of engaging the public attention to goods and services of mass demand produced usually by small companies. That is why the necessity to have inexpensive, simple, and reliable display devices is very pressing.

Among devices capable to meet this necessity by its technical nature the nearest is the display device by US Patent 4,689,604, which comprises —

an annular drum as a carrier of LSs;

a rotary drive kinematically associated with said carrier through a shaft;

three LSs columnar banks arranged as displaying pillars on the external lateral area of the drum face, each bank including a plurality of LSs;

a LSs control unit including a microprocessor, a position sensor to signal the carrier position, a synchroniser to synchronise the operation of LSs, and a program device to receive and process the image data into commands to cut LSs in and out.

In operation, an advertising message scrolls across the drum in the direction opposite the drum rotation, and the total message may consist of a plurality of frames. Each frame covers a span less than the drum periphery and includes a start LSs column and a spaced end LSs column. The position sensor initiates the microprocessor and generates a sequence of sync signals unified for each demonstration pillar. So, during each drum revolution the control unit sets the operation sequence for each LSs bank and synchronises the operation of each display column.

In this device, for the reason that the visualisation of advertising images takes place directly on the background of clearly visible drum, the efficiency of advertising is essentially reduced because long ago exhibition visitors and shoppers got used to luminous images on arbitrary carriers. So, when looking for goods and services of mass demand, people usually inattentive to advertising if it has no a specific target.

Brief description of invention

Generally, the purpose of the invention is to provide a programmed stroboscopic display device offering the visualisation of advertising messages involving concurrently the amazing effect of an image "hovering (dangling) free in the air" (viz the free-hovering effect).

This purpose is accomplished in a stroboscopic display device including —

at least one carrier of light sources (LSs);

a rotary drive kinematically associated with said carrier through a shaft;

a plurality of LSs arranged on the external surface of said carrier;

a LSs control unit comprising a microprocessor, a position sensor to signal positions of said carrier, a synchroniser to synchronise the operation of LSs, and a program device to receive the display image data and process it into commands to cut in and out said LSs; herewith,

in accordance with the invention, —

(a) all the LSs are point light sources;

(b) the carrier is formed as a rod cantilevered onto the rotary drive shaft,

this carrier having its —

shape corresponding to an appropriate revolution body generatrix,

thickness commensurable to the cross section of a point LS,

width, measured radially, sufficient for such a carrier to illusorily disappear from the spectator vision field during gyration;

(c) the optical axis of each LS is perpendicular to the revolution body generatrix which is defined by the selected shape of carrier.

In this device, as point LSs there can serve, for example, light diodes and/or butt ends of fibre lightguides widely known in the art and commonly available.

Owing to the fact that in gyration thin carriers, positioned distantly from the power shaft axis, illusorily disappear from the spectator vision, the above described combination of the device features provides for an optical illusion that displayed apparent volumetric and dynamic advertising messages are hovering free in the air. Thus, for some moments, even experts in optics consider such messages mysterious and attractive. So, it is possible to provide for miscellaneous advertising effects by selecting the needed appropriate revolution body generatrices. With carriers arranged as circular arcs or ellipses, for example, there can be displayed staying or moving advertising messages on illusorily invisible to spectators surfaces of spheroids or ellipsoids. Various shapes of such carriers suggested below can provide for freely hovering in the air volumetric images formed as vases, teapots, breaking fountain sprays, etc.

The principal difference of light effects, achievable with the help of this stroboscopic display device, from similar effects, achievable with the help of popular in show business laser displaying systems leaving in the air clearly visible light lines extending from laser projectors to images, consists in the presence of the above free-hovering effect.

The first additional distinction of this invention is that —

(a) the carrier thickness m is determined by the expression

$$d_{pls} < m \leq 9d_{pls}$$

where d_{pls} is the cross-section of the light emitting surface of a LS;

(b) the carrier width B is determined by the expression

$$B \leq 0.1R_{max}$$

were R_{max} is the radius of the circle described by the LS which is maximally

distanced from the drive shaft axis. With these dimensions and a display frame motioned at a speed of 16 to 25 s^{-1} (or higher), which is generally acceptable to display devices, the free-hovering effect for advertising messages is guaranteed.

The second additional distinction of this invention is that onto the rotary drive shaft and in the geometrical plane of said carrier there is cantilevered an opposite balancer intended to improve the stability of this carrier in gyration (especially while under a wind force).

The third distinction of this invention, additional to the second one, is that the balancer also is a carrier shaped correspondingly to an appropriate revolution body generatrix, the balancer external area equipped with a plurality of LSs associated with the LSs control unit. Thus, for an advertising message under display, there can be created an arbitrary background variably coloured at will, or there can be combined the different parts (e. g., pictures and texts) of the same message. In accordance with the required additional advertising effects and well known in the art balancing principles of theoretical mechanics there is a possibility to change widely the geometrical form of the balancer, its weight, and its distance from the drive shaft axis. To simplify manufacturing and mounting the balancer, it is preferred to be formed as a vertical straight projection, though other forms of it are potential as well.

The fourth distinction of this invention, additional to the third one, is that the interior of the main carrier and/or of the balancer, which faces the drive shaft axis, is equipped with additional LSs; this allows to either obtain luminous volumetric messages in relief if the additional LSs are arranged only in the main carrier interior or, if the balancer interior is also equipped with such additional LSs, obtain the effect of mild shading the text information which is displayed through the LSs situated in the main carrier exterior.

The fifth additional distinction of the invention is that in the geometrical planes, situated at angles of $0° < \varphi < 180°$ in respect to the geometrical plane of said carrier, there being positioned at least one additional carrier with LSs placed onto the external side of it and associated with the LSs control unit; this carrier also shaped correspondingly to a revolution body generatrix. In this case the stroboscopic effect is obtained easily, since the more of additional carriers are mounted onto the common drive shaft with preferably equal angular

spaces in between the lower is the required shaft speed in comparison with the generally accepted minimum speed of 16 s^1. The decrease, obtained by lowering the drive shaft speed, in mechanical (aerodynamical also) loads to the main carrier and to additional ones allows to increase essentially the radii of circles described by the LSs of each carrier, which are maximally remote from the drive shaft axis. Hence, with such an increase in said radii, the size of message hovering in the air being considerably enlarged, thereby the efficiency of advertising being augmented.

The sixth distinction of the invention, additional to the fifth one, is that the main and the additional carriers being shaped and dimensioned identically and positioned at angles which are approximately aliquot to 45°. Such a mode of production of carriers offers simplicity and favours easy balancing the device inertial weights.

The seventh distinction of the invention, additional to the fifth and the sixth ones, is that each carrier has in its geometrical plane an oppositely cantilevered balancer. In gyration, the stability of carriers is thereby improved which is, as mentioned above, important when under wind load.

The eighth distinction of the invention, additional to the seventh one, is that each balancer is shaped correspondingly to an appropriate revolution body generatrix and exteriorly equipped with a plurality of LSs associated with the LSs control unit. In advertising, it offers a possibility either to create and change at will the message combined colour background or combine the different parts (e. g., pictures and texts) of the same message simultaneously varying the message colour.

The ninth distinction of the invention is that the stroboscopic display device is furnished with at least one additional rotary drive shaft distanced from the main drive shaft and rotationally synchronised with the latter by an appropriate synchronising means, the additional shaft having at least one carrier cantilevered onto it and shaped correspondingly to an appropriate revolution body generatrix. Such a quantitative increase in drive shafts, spatially positioned and furnished with carriers, allows an essential augmentation in advertising means.

The tenth distinction of the invention, additional to the ninth one, is that the main drive shaft and at least one additional drive shaft are associated with the

common motor through a synchronising mechanical transmission which can be any of gear- or chain-type known in the art. When such a transmission used, the electronic control means to cut in and out the LSs of different drive shafts may be chosen the simplest one.

The eleventh distinction of the invention, additional to the ninth or tenth one, is that each pair of adjacent and positioned in parallel drive shafts is synchronised in phase; the space *A* between the shaft pairs expressed as

$$A < max\ R_i + max\ R_{i+1}$$

where $max\ R_i + max\ R_{i+1}$ is the radii sum of the circles described by the LSs which are maximally distanced from the axis of the corresponding shaft.

From above, it can be seen that each of such shafts has a plurality of its own carriers. These carriers may be different or, preferably, shaped identically to the same corresponding revolution body generatrix; and when shaped so, they may be differently dimensioned in length. Thus, depending on a display program, there can take place, acting either gradually or instantaneously, transition-penetration interactions of advertising message parts from the surface described by one carrier onto the surface described by another; in acting so, an extra effect of colour interactions is also involved.

The twelfth distinction of the invention, additional to the eleventh one, is that the stroboscopic display device is furnished with more than two drive shafts placed in parallel; each shaft having straight and identically shaped carriers equally spaced in respect to their initial angular positions. It is, therefore, possible to display large and visible from afar advertising messages on illusorily invisible to spectators, predominantly cylindrical, surfaces complementing each other and sequentially hovering in the air; as a matter of fact, these surfaces produce an undulating "screen".

The thirteenth distinction of the invention, additional to the twelfth one, is that each drive shaft, except for the first and the last ones, has an additional straight long carrier mounted together with the main carrier; the first and the last drive shafts having only short carriers shaped, dimensioned, and angularly positioned as the main carriers. The advantage of this particular embodiment of the invention consists in that that the short carriers provide for fabricating the main "screen" hovering freely in the air and illusorily invisible to a spectator, but the long carriers provide for fabricating an additional "screen", also hovering in

the air freely and equidistantly from the main "screen". Onto the additional "screen", a message can be introduced either simultaneously with filling the main "screen" or individually at a speed adjustable by the operator. Both "screens" can be used to display simultaneously the different parts of the same message, having a needed colour spectrum, or different messages which can be seen separately at viewing angles of 35° to 75° in respect to a perpendicular dropped onto the surface of any "screen".

The fourteenth distinction of the invention, additional to the ninth one, is that the stroboscopic display device is furnished with two coaxial drive shafts positioned with an axial space between them; each shaft having at least one carrier shaped correspondingly to a needed revolution body generatrix and cantilevered onto said space. Such an arrangement provides for either completely interpenetrating the displayed volumetric luminous messages or absorbing one message by another at a desired speed.

The fifteenth distinction of the invention, additional to the fourteenth one, is that the coaxial drive shafts are associated with the common motor by means of a synchronising mechanical transmission furnished with a regulator to vary the axial space between the shafts. To compel the attention of customers to the advertising message, this mechanism motions forward and backward the parts of the same message or the messages complementing each other.

Brief description of drawings

To explain the structure and the operation of the invention in detail there are drawings where —

fig. 1 is a general block diagram of the stroboscopic display device having one rotary drive shaft with the main carrier and the balancer with LSs identical to those of the main carrier; the main carrier and the balancer differently shaped and dimensioned and both oppositely cantilevered onto the shaft;

fig. 2 is a geometrically simplified diagrammatic arrangement (side view) of the LSs shown in fig. 1;

fig. 3 is a diagrammatic top view of the main carrier and the balancer which are shown in fig. 1;

figs. 4 to 13 are diagrammatic examples of potential shapes and appropriate revolution body generatrices of carriers;

fig. 14 is a diagrammatic example of LSs arrangement for the external and

the internal surfaces of the main carrier and the balancer which both are oppositely cantilevered onto the same drive shaft;

fig. 15 is a diagrammatic arrangement of the LSs shown in fig. 14 (side view) with geometrically defined dimensions;

fig. 16 is a diagrammatic arrangement (top view) of the LSs shown in fig. 14; the shift angle of message parts, which arrives during the drive shaft rotation, shown also;

figs. 17 to 19 are geometrical diagrams (front views) of preferred arrangements for one, two, and three pairs of main carriers and balancers cantilevered onto the same drive shaft;

fig. 20 is a diagrammatic top view of the stroboscopic display device having two parallel rotary drive shafts;

fig. 21 is a diagrammatic side view of the same device as in fig. 20, but here it is shown together with a drive outline and a diagram of interpenetrating messages;

fig. 22 is a diagrammatic side view of the stroboscopic display device having a plurality of parallel drive shafts;

fig. 23 is a diagrammatic top view of same device as in fig. 22, but here it is shown together with a part of its body;

fig. 24 is a diagrammatic side view of the stroboscopic display device having two coaxial drive shafts.

Best modes of invention embodiment

In its simplest and ordinarily used form of embodiment (fig. 1), the stroboscopic display device comprises —

body 1, preferably hollow one, to accommodate a plurality of below mentioned assemblies, units, and association means;

rotary drive 2 fixed in body 1;

at least one output shaft 3 of rotary drive 2;

at least one carrier 4 to carry on its external surface a plurality of point LSs 5 (as LSs there can serve, for example, commonly available light diodes or butt ends of fibre lightguides);

control unit 6 to cut in and out said LSs 5 associated with unit 6 through an appropriate commutator (not shown), and

power unit 7 associated with rotary drive 2 through control unit 6; if need

be, power unit 7 can be equipped with a suitable and commonly available standard voltage stabiliser.

Carriers 4 can have balancers 8 which, if required, can be equipped with LSs as well; these balancers described below in detail.

Rotary drive 2 is usually assembled on the basis of at least one electric motor equipped, if need be, with a reduction gear and other mechanical means to rotate two or more output shafts 3. Such members of rotary drive 2 are not shown in the drawings for the electric motor is commercially available, and the reduction gear and the other mechanical means may be manufactured individually by common practice.

Control unit 6 may be assembled on the basis of such appropriate units as a microprocessor, a position sensor for carrier 4, and a synchroniser to synchronise the operation of LSs. These members are also not shown owing to their commercial availability. As the basis of control unit 6, there can be a controller similar to that of US Patent 4,967,373. It is understandable to those skilled in the art that control unit 6 is equipped with hardware and software means to adequately record and process the data for text and/or picture messages to be displayed and, as a result, to generate commands for cutting in and out corresponding LSs. Besides, the microprocessor of control unit 6, using a suitable software, can function as a direct synchroniser, and this software, provided for the device according to this invention, is usually prepared in view of a particular form of the invention embodiment. In preparing such a software there are considered, separately and jointly, stipulation factors, the examples of which are —

the shape and dimensions of each carrier 4;

the number and spatial positions of carriers 4 and balancers 8 mounted onto each separate shaft 3 of rotary drive 2 and equipped with LSs;

the number and spatial positions of shafts 3 of drive 2;

the number, type, and colour of LSs, placed onto each carrier 4 and balancer 8;

the type of data to be used in advertising with reference to particular segments of a given market;

the number of simultaneously displayed messages.

In a common case (left sections of figs. 1 and 2) there is cantilevered onto

shaft 3 of rotary drive 2 one carrier 4, shaped correspondingly to an appropriate revolution body generatrix, which has its thickness, commensurable with the cross sectional dimension of LS 5, and its width, measured radially, both sufficient for carrier 4 to illusorily disappear from the spectator vision when shaft 3 rotated; the optical axis of each LS 5 of carrier 4 perpendicular to the surface of the revolution body generatrix of carrier 4 (fig. 2). To have qualitative volumetric images of spherical objects, it is necessary to position LSs 5 onto carrier 4 so that the geometrical lines of LSs 5 intersect near the geometrical centre of the given object, the intersection error not over 5 % when measured by the divergence angle.

It is advisable that in the geometrical plane of carrier 4, as shown in figs. 1, 2 and, particularly, 3, there should be cantilevered onto shaft 3 of rotary drive 2 opposite balancer 8. This balancer is an arbitrarily shaped counterbalance to carrier 4, which is, preferably, an additional carrier with LSs 5 arranged on its exterior side (figs. 1 and 2). As shown in fig. 3, balancer 8 may be shaped correspondingly to its revolution body generatrix, either identically to main carrier 4 or diversely, and distanced from the axis of shaft 3 with a, preferably, greater space than that of carrier 4. In addition, the thickness m of carrier 4 (fig. 3), or balancer 8 having LSs 5, should be selected by the expression

$$d_{pls} < m \leq 9\, d_{pls}$$

where d_{pls} is the cross-section of the light emitting surface of a point LS; and width B of carrier 4 (fig. 2) should be selected by the expression

$$B \leq 0{,}1\, R_{max}$$

where R_{max} is the radius of the circle described by LS 5 maximally distanced from the axis of shaft 3 (fig. 2).

As theoretical examples of revolution body generatrices there can serve —

a straight line for a cylinder or cone;

an arc of a circle for a sphere;

different arcs, preferably smooth arcs, such as of an ellipse, hyperbola, parabola, etc. for, correspondingly, an ellipsoid, hyperboloid, paraboloid, etc.;

arbitrary combinations of straight lines and/or arcs of identical and/or different arcs.

Some particular examples of possible revolution body generatrices for main carrier 4 are shown in figs. 4, 6, 8, and for few combinations of carrier 4

with balancer 8, both having LSs 5, in figs. 10 and 12; figs. 5, 7, 9, 11, and 13 showing the corresponding revolution bodies of such combinations. It is clear, of course, that these examples by no means limit the number of possible revolution body generatrices which can be selected among others at will by the advertiser.

Among simple examples of the invention embodiment there is a particular variant corresponding to both (left and right) parts of figs. 1 and 2 and figs. 10 and 11. It can be seen in figs. 1 and 2, and especially in fig. 10, that LSs 5 of main carrier 4 encompass an angle over 90°, preferably about 180°, whereas those of balancer 8 encompass an angle usually ranged from 10° to 40°. In arranging LSs 5 on balancer 8, it is advisable that they should be positioned approximately opposite to corresponding LSs 5 situated in the mid part of main carrier 4.

More complicated variants of the device according to the invention are possible also. In the variant of fig. 14, for example, there is at least one carrier with its internal side, facing the rotation axis of shaft 3, additionally equipped with LSs 5; and it is of no importance if there is either only one main carrier 4, or only one balancer 8, or both of them. Any number of carriers 4 and any number of balancers 8 can be cantilevered onto any number of output shafts 3 either directly or by brackets having no LSs, and it is preferred that in any case these units are mounted detachably in order to have a possibility to repair or replace them. Some examples of such brackets, not indicated particularly, are shown in figs. 1, 2, 10, and 12 as parts of balancers 8.

It is rational that in the geometrical planes (figs. 18 and 19), situated at angle φ with respect to the geometrical plane of main carrier 4, there was at least one additional carrier 4' (4", etc.) also shaped correspondingly to an appropriate revolution body generatrix. This angle should be selected from the range of $0° < \varphi < 180°$. It is advisable, again, that main carrier 4 and additional carrier 4' (4", etc.) should be identically shaped, dimensioned, and positioned under angles which are aliquot to, approximately, 45°. Naturally, it is also advisable that each carrier 4 (4', 4", etc.) should have in the same geometrical plane balancer 8 (8', 8", etc.) oppositely cantilevered onto shaft 3, shaped correspondingly to an appropriate revolution body generatrix, and exteriorly equipped with LSs 5 associated with control unit 6. In this case, every balancer

8 (8', 8", etc.) may be shaped, dimensioned, and equipped with LSs identically to every corresponding carrier 4 (4', 4", etc.).

With such pairs of carriers and balancers cantilevered onto the same shaft 3 increased in number, there arrives a possibility to provide the stroboscopic effect with shaft 3 rotating much slower. Hence the inertia of gyrated parts decreased and the diameters of revolution body described by LSs 5 essentially increased. When this takes place, there, of course, arrives the necessity to increase the rigidity and stability in the tops of carriers 4, 4', 4", etc. and balancers 8, 8', 8", etc., which can be achieved by adding some mechanical parts (not shown).

To easily mount, maintain, and repair all carriers 4, 4', 4", etc. and balancers 8, 8', 8", etc. acting as carriers, it is advisable that all such units should be constructively unified. There is no need to describe the assembling conditions for such units as they are well known in the art.

To enlarge considerably the number of advertising means, the device according to the invention may be equipped with at least one additional shaft 3' of rotary drive 2 (figs. 21 and 24). This being the case, shaft 3' is spatially situated in respect to main shaft 3, rotationally synchronised with it through an appropriate means, and furnished with at least one cantilevered carrier 4 having an appropriate revolution body generatrix. It is clear that the drawings show only these two shafts with the aim to better understand the invention capabilities, but the number of such shafts can be much more. In some variants of the invention embodiment, it is preferred that main shaft 3 and at least one additional shaft 3' are placed in parallel and associated with rotary drive 2 through a synchronising transmission 9, such, for example, as a toothed gearing or a chain-drive, (figs. 20, 21, and 22). The distance A between the axes of two adjacent parallel shafts 3_i and 3_{i+1} may range widely, for it can be either larger than, or equal to, the sum $(maxR_i + maxR_{i+1})$ of the radii of the circles described by the LSs distanced maximally from the shaft axes. So, for simultaneously displaying the separate messages, the device according to the invention, which has $A \geq maxR_i + maxR_{i+1}$, is the more preferred the more the distance A exceeds this sum. However, as shown below in the device operation description, the cases when each pair of adjacent parallel shafts 3_i and 3_{i+1} is synchronised in phase and spaced in accord to $A < maxR_i + maxR_{i+1}$,

are especially suitable for advertising.

In the simplest variant of the invention embodiment shown in fig. 21, it is advisable that each shaft should have a pair of cantilevered and positioned under right angle main carrier 4 and additional carrier 4', both, preferably, dimensioned differently. Particularly, main carriers 4 can be shaped as circle arcs of various diameters, but additional carriers 4' — as vertical straight bars. It is advisable also that said carriers of each said pair should have shortly bracketed balancers 8.

In rather complicated specific versions of the invention embodiment (figs. 22 and 23), the device is furnished with more than two parallel shafts 3; each shaft 3 having identical carriers 4 positioned in equal original positions. This being the case, it is expedient that —

each shaft 3, positioned between first shaft 3 and last shaft 3, should have, besides main carrier 4, additional straight carrier 4' being greater than main carrier 4, and

first shaft 3 and last shaft 3 should have only carriers 4 identical in shapes, dimensions, and angular positions to those of main carriers 4.

In one more particular version of the invention embodiment (fig. 24), the device is furnished with two coaxial shafts 3 and 3' placed sequentially with an axial space; each shaft 3 or 3' having at least one cantilevered carrier 4 shaped correspondingly to an appropriate revolution body generatrix and placed between shafts 3 and 3' into said axial space. To obtain additional optical effects, coaxial shafts 3 and 3' are associated with a common motor through a synchronising mechanical transmission equipped with control unit 10 to adjust said axial space between shafts 3 and 3'.

It is quite understandable that along with said examples of parallel and coaxial arrangements of shafts 3 positioned in one plane, there are possible other variants of the invention embodiment. It is possible, thus, to arrange several parallel shafts 3 in the tops of an arbitrary (not necessarily equilateral) polygon. So, in accord with desirable optical effects, at least two shafts 3 can be arranged in such a way that their axes being situated at an angle either in one plane or in different planes; the axes, as a result, correspondingly intercepting in one point or crossing each other.

It is comprehensible also that to power light diodes LSs from power unit 7,

there can be used, for example, a suitable electromechanical commutator (not shown) associated with control unit 6; the commutator being, for example, as a set of "ring-brushes" accommodating the needed contact pairs in accord to the number of LSs 5 located in corresponding shaft 3. Similarly, when using butt ends of fibre lightguides as LSs, there can be employed, for example, a suitable optoelectronic commutator.

The operation of the stroboscopic display device according to the invention is as follows.

Into control unit 6, irrespectively of a particular variant of the device embodiment, there is entered an advertising message. For this purpose there can be employed such known pieces of hardware as keyboards (for texts), scanners (for images), computer disc drives (for any message previously recorded), etc. Further, unit 6 forms a sequence of command signals to cut in and out LSs 5 and a ready signal to start the device; in doing so, unit 6 considers some or all the above programmed factors among which there are always present the number and the initial positions of carriers of LSs 5. In starting rotary drive 2, control unit 6 controls the rotation of output shaft 3 and, on arriving the specified speed of it, introduces said sequence of command signals into action. If there are several shafts 3, the advertising process starts only after each shaft has reached its operational speed.

Due to the fact that the image "frames" are changing at a speed exceeding the human vision persistence time, there arrives the effect of free hovering in the air of at least one image (picture and/or text) on the surface illusorily invisible to spectators; this effect being the principal display effect obtainable in any case independently of a particular design of the device. In the simplest case (figs. 1 to 3, with no regard to LSs of balancer 8, and figs. 4 to 9) this effect can be watched, so to say, in pure state. Really, with carrier 4 being thin and gyrating at a speed of $\geq 16\ s^{-1}$, this carrier illusorily disappears from the spectator vision, and the luminous characters and lines, formed with rotationally synchronised flashes produced by groups of LSs 5, "hover" in the air actively attracting the attention of potential customers to advertised goods and services. This free-hovering effect is the more surprising the closest is the thickness m of carrier 4 to the cross-section d_{pls} of the light emitting surface of point LS 5 and the smaller is the width B of this carrier in relation to the radius R_{max} of the circle

described by LS 5 maximally distanced from the axis of shaft 3.

In more complicated designs of the device, said effect can be complemented by other light effects which augment the attraction of spectators. For example, during the operation of the device designed in accordance with the same figs. 1 to 3, but with balancer 8 having LSs 5 as shown in fig. 10, additional LSs 5 of balancer 8 create an illusorily invisible belt encircling the also illusorily invisible revolution body described by LSs 5 of main carrier 4 (fig. 11). By combining this belt and said revolution body, there can be simultaneously displayed either various complementary parts of the same message or miscellaneous messages overlapping each other. Since LSs 5 of balancer 8 less numbered, this belt usually displays texts or simple pictures, preferably in the running string mode, but said illusorily invisible revolution body displays more complicated messages. Still more complicated light effects are provided with the device according to the invention having additional LSs 5 on the interior side of carrier 4 and/or balancer 8 (fig. 14). The device so designed can display either volumetric images in relief (usually by backlighting the basic image, created by the flashes of exterior LSs 5 of carrier 4, with the flashes of interior LSs 5 of this carrier) or text messages slightly shaded (usually by LSs 5 of both sides of balancer 8, which are specifically operated).

With shaft 3 rotating, the above additional effects are obtained as a result of an optical illusion that interior LSs 5 of carrier 4, or balancer 8, are displaced for distance x and angle α in respect to the exterior ones (figs. 15 and 16). It is understandable that the more wide is carrier 4, or balancer 8, measured radially, the more significant are x and α, and, accordingly, the more notably relieved or shaded is the message.

It is possible to decrease the rotation speed of shaft 3 twice as much, or four times as much, if this shaft has two, or four, pairs of carriers 4 (figs. 18 and 19 compared to fig. 17). The flicker of carriers 4 during gyration, which is possible with such a decrease, is successfully masked by additional or decorative details of a message or by a considerable enlargement (up to 1 m and more) of displayed texts and/or pictures.

The device of fig. 21, in which one pair of parallel shafts 3_i and 3_{i+1} is synchronised in phase and positioned with an axial space of $A < maxR_i + maxR_{i+1}$, provides for one more effect, especially exotic and attractive, involving

the interpenetration and/or translocation of volumetric luminous pictures and texts (fig. 22). The interpenetration and/or translocation can take place at various speeds in accord to the program loaded into control unit 6; and the more the colours of LSs 5 of various carriers 4 and/or balancers 8, located in different shafts 3, mixed and/or changed the more the effect augmented.

Again, the device of fig. 22 forms an illusorily invisible undulating "screen" displaying fixed or movable messages (fig. 23). In doing so with two, or more, parallel shafts 3 rotating in phase, identical straight carriers 4 form a combination of illusorily invisible cylindrical surfaces. This combination displays, on all its surface or on a part of it, either the pieces of the same message, which are complementing each other and undulating in the air, or at least one message undulating alone across this "screen". Of course, the speed and/or direction of the movement of the whole message or only the pieces of it can be adjusted at will if there is an appropriate software.

If in each intermediate shaft 3 of the device there are used additional longer carriers 4' and in the first and last shafts 3 jointly used additional carriers 4 identical to main carriers 4, it can, therewith, create two equidistant "screens" freely hovering in the air and —

either form on each "screen" various (specifically pictorial and textual) message pieces complementing each other and visible simultaneously to the same spectator under an angle deviating from the right angle in the range of, approximately, ± 45°

or display differently on each "screen" different messages simultaneously visible to many spectators under different angles.

During operation, furthermore, the device of fig. 24 can change the height of the same image or the interpenetration depth of different images. For doing so, it is enough to change the axial space between coaxial shafts 3 and 3' by means of control unit 10.

It is necessary to note, in conclusion, that with shaft(s) 3 of drive 2 rotated steadily and due to the vanishingly small inertia of point LSs there is a possibility in any particular version of the invention embodiment to vary widely the speed and/or direction of any displayed message by using an appropriate software.

Industrial applicability

The device according to the invention can be easily mass-produced in order to be available to advertisers of small- and middle-scale business. It can display arbitrary messages as pictures and/or texts accompanied by the amazing effect of free hovering in the air. This amazement develops the well-known psychological effect of subconscious transfer of advertising message perception into the perception that advertised goods and services (especially new ones) should be acquired. In exhibitions and fairs, the extensive usage of even simply designed devices according to the invention for displaying trade marks and service signs with advertising messages in turn can essentially facilitate the efforts of exhibitors to attract the attention of visitors.